PROJECT DATA

Nimitz, Inc. dba ETEC - 02GO12067

High Energy Efficiency Air Conditioning

Recipient:	Nimitz, Inc. dba ETEC	Instrument Number:	DE-FG36-02GO12067
Recipient Project Director:	Jonathan Nimitz 505.341.2707 4500 Hawkins St. NE, Ste. B Albuquerque, NM 87109-4541	CPS Number:	1839
		HQ Program Manager:	Lisa Barnett 202.586.2212
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Recipient Type:	For-Profit Organization	GO Contract Specialist:	Melissa Wise 303.275.4907
Subcontractor(s):		B&R Number(s):	ED1906020
		PES Number(s):	02-2140
EERE Program:	Building Technologies	State Congressional District:	NM - 1

PROJECT SCOPE: The objective of this project is to demonstrate the suitability of Ikon® B refrigerant for use as a high energy efficiency refrigerant in residential and small commercial air conditioners. Ikon® B will be tested, versus R-22, in a typical residential split-stem central air conditioner under controlled environment conditions. Cooling capacity and energy efficiency will be baselined with R-22. Energy consumption is expected to be reduced 20 to 25%. Potential economic savings are estimated at more than 40 billion kWh/yr by 2010; about $4 billion/yr cost savings.

FINANCIAL ASSISTANCE

Approved DOE Budget:	$199,971	Approved DOE Share:	$199,971
Obligated DOE Funds:	$199,971	Cost Share:	$0
Remaining Obligation:	$0		
Unpaid Balance:	$1	**TOTAL PROJECT:**	**$199,971**

Project Period: 08/01/02 to 07/31/03

TECHNICAL PERFORMANCE
DE-FG36-02GO12067
Nimitz, Inc. dba ETEC
High Energy Efficiency Air Conditioning

PROJECT SYNOPSIS

The goal is to demonstrate the suitability of Ikon® B refrigerant for use as a high energy efficiency refrigerant in residential and small commercial air conditioners. Ikon® B will be tested versus R-22 in a typical residential split-system central air conditioner under controlled environment conditions. Cooling capacity and energy efficiency will be baselined with R-22. The unit will then be modified for use with Ikon® B and its cooling capacity and energy efficiency measured to determine the improvement. Ikon® B is one of an advanced family of nonflammable, non-ozone-depleting refrigerants that have good cooling capacity and high energy efficiency. Ikon® B also has low global warming potential and is approved by the U.S. EPA as a replacement for ozone-depleting refrigerants. Energy consumption is expected to be reduced 20 to 25%. The DOE's Energy Information Administration data indicates that about 830 trillion Btu, or about 240 kWh of electricity, will be used in residential and commercial building comfort cooling in 2002. At an average price of $0.083/kWh, this is a cost of $19.9 billion to the American public. A technology that reduces this use by 20% will give savings of almost $4 billion per year. Economic savings are estimated at more than 40 billion kWh/yr by 2010 if the technology is quickly adopted, or about $4 billion/yr cost savings.

SUMMARY OF TECHNICAL PROGRESS

The project is complete, and the final report has been received.

SUMMARY OF PLANNED WORK

No more work is planned for this project.

PROJECT ANALYSIS

The project was very successful. All objectives were achieved. Performance testing showed that the Ikon® B refrigerant can easily be retrofitted into R-22 air conditioners to give 15-20% energy savings. A one to three year payback of retrofit costs was estimated, depending on location and use. It would be appropriate to consider this an emerging technology.

ACTION REQUIRED BY DOE HEADQUARTERS

No action is required from DOE Headquarters at this time.

STATEMENT OF WORK
DE-FG36-02GO12067
Nimitz, Inc. dba ETEC
High Efficiency Air Conditioning

PROJECT GOAL

The project goal is to demonstrate the suitability of Ikon® B refrigerant for use as a high energy efficiency refrigerant in residential and small commercial air conditioners. Ikon® B will be tested versus R-22 in a typical residential split-stem central air conditioner under controlled environment conditions. Cooling capacity and energy efficiency will be baselined with R-22. Energy consumption is expected to be reduced 20 to 25%. Potential economic savings are estimated at more than 40 billion kWh/yr by 2010; about $4 billion/yr cost savings.

PROJECT OBJECTIVES

The project objectives are to:

- Obtain and install an air conditioner in ETEC's walk-in environmental chamber.
- Baseline air conditioner energy use with and without a perfluorinated compound (PFC).
- Measure air conditioner energy use with Ikon® B, with and without a PFC.
- Run air conditioner over an extended period of time with Ikon® B and test for incompatibilities.

DETAILED TASK DESCRIPTION

Task 1. Obtain and Install Air Conditioner

The purpose of this task is to procure and install the necessary equipment to test and demonstrate Ikon® B in a standard air split system central air conditioner. A typical new two ton, split system, R-22 residential air conditioner will be purchased, installed in ETEC's walk-in environmental chamber, and instrumented for performance testing. The refrigerant lines between the condenser unit and evaporator unit will be 15 feet long to simulate these line lengths in a typical split system installation. An appropriately sized fan will be added on the evaporator to provide cooled air circulation. The evaporator air inlet and outlet will be connected by a loop of duct containing approximately 24,000 Btu/h heaters to reheat the cooled air. Alternately, the cooled evaporator outlet air will be mixed with ambient air from the chamber to achieve the desired evaporator inlet air temperature. The condenser air inlet will be taken from the environmental chamber ambient air. The condenser air outlet will be ducted to the environmental chamber return air to be cooled for recirculation to the chamber. A PFC device will be installed on the compressor with a cutout so it can be taken out of the power circuit when desired. Thermocouples will be installed at critical points such as the compressor inlet and outlet, the expansion valve inlet, the expansion valve outlet, along the evaporator and condenser coils, evaporator and condenser outlets, and air temperature entering and exiting the evaporator and condenser. Pressure transducers will be installed on the compressor inlet and outlet and the inlet line to the expansion valve. A Watt-hour meter for single-phase 230V power will be installed on the unit's power line to measure its energy use.

Task 2. Baseline Air Conditioner Energy Use

The purpose of this task is to establish baseline energy efficiency values for the air conditioner in our experimental setup with its standard R-22 refrigerant. Energy use of the air conditioner will be measured at constant 24,000 Btu/h heat load with the air conditioner's standard R-22 charge and at condenser ambient temperatures of 90 and 100°F. At least three runs will be made at each condenser ambient temperature with the PFC device out of the compressor power circuit, and at least three runs with the PFC device in the compressor power circuit, to obtain baselines for the unit and for the effect of the PFC device on unit power use. The multiple runs will allow relative standard deviations to be calculated for the results.

Task 3. Measure Energy Use with Ikon® B

The purpose of this task is to measure the improvement in energy efficiency values for the air conditioner with Ikon® B installed. First, the R-22 refrigerant will be removed from the air conditioner and a new expansion valve installed. Because Ikon® B has a significantly lower evaporator pressure than R-22, the R-22 expansion valve on the air conditioner would cause Ikon® B to operate at a wrong and inefficient pressure. Expansion valves must be matched to the refrigerant being used. Ikon® B's operating pressures are very similar to those of R-12, so an R-12 expansion valve can be used in place of the R-22 expansion valve. Alternatively, a valve whose sensor bulb is filled with Ikon® B will be used. After the expansion valve is changed and the system is checked for leaks, Ikon® B will be charged to the system. The charge will be a liquid volume of Ikon® B equal to the liquid volume of R-22 specified for the unit. As these units have a receiver and some amount of excess refrigerant to offset small leak losses, an equal liquid volume of Ikon® B should be completely sufficient for efficient operation. Before the full performance test is started, the air conditioner will be run with the initial charge of Ikon® B to verify that it is operating properly. During this pre-test run, the expansion valve superheat will be adjusted to achieve the correct amount of superheat exiting the evaporator.

Once the operational parameters have been checked, the performance test will be repeated. Energy use will be measured with and without the PFC. If necessary, the amount of heat being added to the evaporator return air will be reduced somewhat so that the air conditioner can keep up with the heat load. This may be necessary because of Ikon® B's lower cooling capacity. If the heat load must be reduced, this will be accounted for in calculating the energy use results to assume that the unit must run some percentage longer to provide the extra heat removal. For example, if the heat load must be reduced to 20,000 Btu/h with Ikon® B, the energy use of the unit will be multiplied by 1.2 (i.e., 20% more run time) to give the same 24,000 Btu/h obtained with R-22. Since the large majority of air conditioning systems do not run continuously (i.e., they are somewhat oversized to give fast cooling when they are turned on and to ensure that there is always sufficient cooling), even 20% longer run times could be tolerated. ETEC is expecting closer to 15% less cooling capacity for Ikon® B versus R-22.

Task 4. Perform Extended Run Test with Ikon® B

The purpose of this task is to demonstrate the compatibility of Ikon® B in the air conditioner over an extended run time. Following the energy efficiency measurements, the system will be run for several months. The compressor on time will be logged. Following the extended run time, components of the system will be checked for evidence of any incompatibilities, corrosion, deposits, or decomposition. The refrigerant will be analyzed by gas chromatography for products

of decomposition. The oil will be analyzed for acidity, particulates, viscosity, copper, and iron. The compressor will be broken down and inspected for deposits, corrosion, and/or any excessive wear. Pieces of the refrigerant loop tubing will be inspected for deposits and corrosion.

Task 5. Project Management and Reporting

ETEC is responsible for submitting both Semi-Annual Progress Reports and a Final Report to DOE. The Semi-Annual Reports are due every April 30 and October 31. The Final Report is due 90 days after the project completion date as specified in the agreement. This task also includes other DOE requirements for market assessments, fact sheets, benefits analyses, workshops, etc.

Project Cost Performance in DOE Dollars for Fiscal Year 2003

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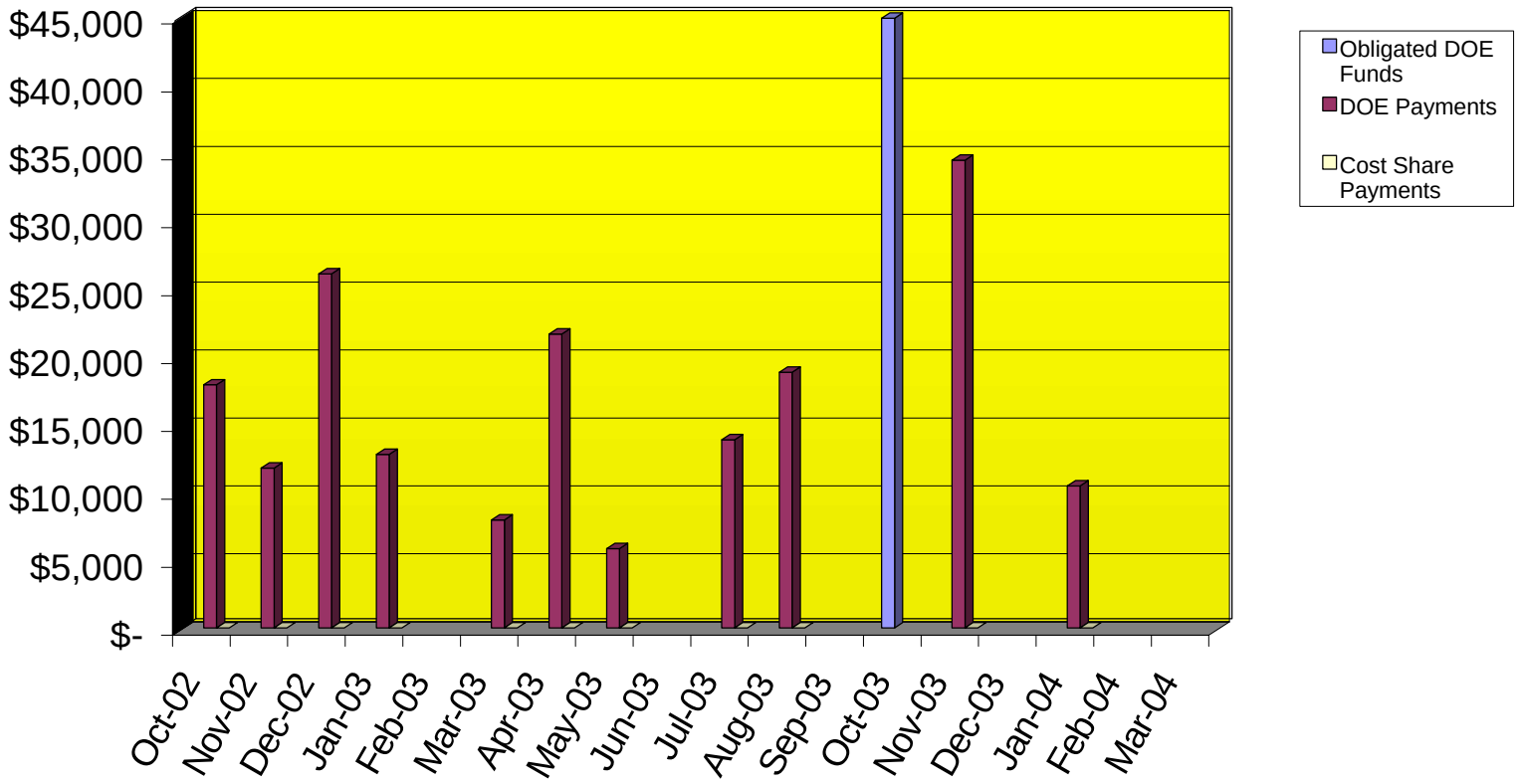
High Energy Efficiency Air Conditioning



	Oct-02	Nov-02	Dec-02	Jan-03	Feb-03	Mar-03	Apr-03	May-03	Jun-03	Jul-03	Aug-03	Sep-03
Obligated DOE Funds	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
DOE Payment	$17,905	$11,765	$26,080	$12,782	$0	$7,953	$21,638	$5,850	$0	$13,857	$18,823	$0
Cost Share Payment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

	Oct-03	Nov-03	Dec-03	Jan-04	Feb-04	Mar-04	PFY*	Cumulative
Obligated DOE Funds	$44,909	$0	$0	$0	$0	$0	$155,062	$199,971
DOE Payment	$0	$34,453	$0	$10,457	$0	$0	$18,407	$199,970
Cost Share Payment	$0	$0	$0	$0	$0	$0	$0	$0

Approved DOE Budget:	$199,971
Approved Cost Share Budget:	$0
Total Project Budget:	$199,971

* Prior Fiscal Years

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